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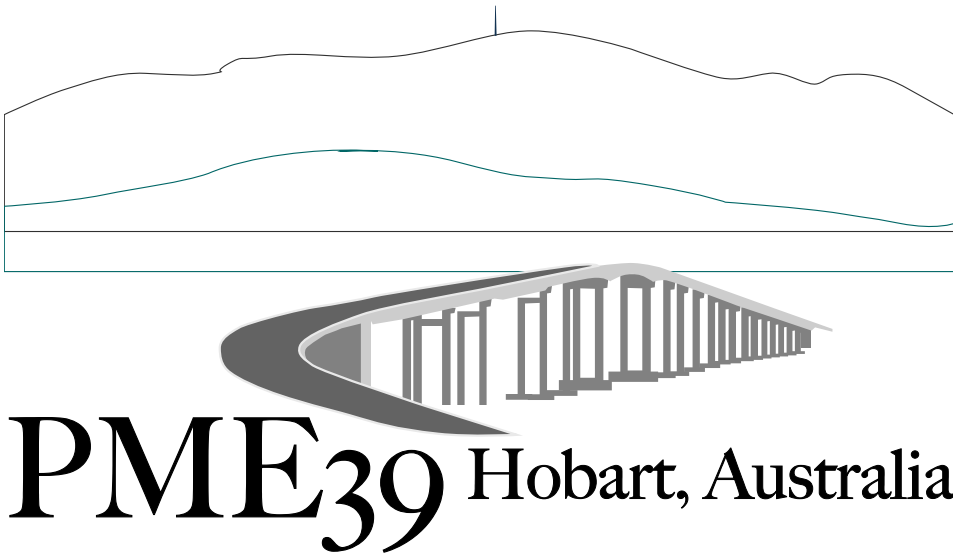

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CRUCIAL EVENTS IN PRE-SERVICE PRIMARY TEACHERS' MATHEMATICAL EXPERIENCE

Cristina Coppola*, Pietro Di Martino**, Tiziana Pacelli*, Cristina Sabena****

* Dip. di Matematica - Università di Salerno, ** Dip. di Matematica - Università di Pisa, *** Dip. di Scienze Umane, Filosofiche e della Formazione - Università di Salerno, **** Dip. di Filosofia e Scienze dell'Educazione - Università di Torino

Relationship with mathematics is a crucial variable in the professional development of pre-service primary teachers: it can largely affect pre-service teachers' reactions to educational prompts and also their future didactical choices in classroom. Many researches showed that pre-service primary teachers have often developed a negative relationship with mathematics during their mathematical experience as students. This paper adopts a narrative methodology to investigate about the origins and development of these relationships. Specifically, it investigates how pre-service primary teachers tell the events that they recognize as crucial for the development of their relationship with mathematics. Results indicate the relevance of success/failure experiences, and the key-role of the teacher therein.

INTRODUCTION AND THEORETICAL BACKGROUND

Research in mathematics teacher education has highlighted the influence of prior experiences with mathematics as students on pre-service primary teachers' professional development. Studies carried out in different countries show that pre-service primary teachers have often lived negative experiences with mathematics and have consequently developed a negative relationship with mathematics (Lutovac & Kaasila, 2014). These negative experiences with mathematics can generate uncertainty, low perceived self-efficacy as future teacher, and produce "deep seated beliefs [that] often run counter to contemporary research on what constitutes good practice" (Liljedahl et al., 2007, p. 320). On the other hand, a reflection about the causes of the difficulties met in the school experiences with math can be the germ for the *math-redemption phenomenon*, i.e. pre-service teachers' desire to reconstruct their personal relationship with math and to avoid the mistakes imputed to their past mathematics teachers (Coppola, Di Martino, Mollo, Pacelli, & Sabena, 2013).

Both for research and for practice in teacher education programs, it appears therefore significant to investigate about the origin and development of the pre-service teachers' different relationships with math.

A narrative approach seems to be particularly suitable for this purpose (Kaasila, 2007). The goal of the narrative approach is to get the narrator to describe stories in which aspects that he/she considers significant come to the fore. As Kaasila underlines, through a narrative approach we can focus not only on pre-service teachers'

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experiences, but also on how they describe them. In particular, Connelly and Clindinin (1990, p. 2) state that:

> The main claim for the use of narrative in educational research is that humans are storytelling organisms who, individually and socially, lead storied lives. The study of narrative, therefore, is the study of the ways humans experience the world. This general notion translates into the view that education is the construction and reconstruction of personal and social stories; teachers and learners are storytellers and characters in their own and other's stories.

The narrative study conducted by Di Martino and Zan (2010) about school students' relationship with mathematics shows that students identify some specific events as crucial for the development of their relationship with mathematics. Moreover, they are often characterized by the description of *ruptures*, i.e. these events constitute what Bruner (1990) calls *turning points*. As Bruner observes, when an important rupture occurs in the plot of a personal story, the narrator usually recalls and describes with most details and emotional transport a specific event (or some events) related to this rupture. In the context of mathematics education, Drake (2006) carried out a very interesting narrative inquiry focused on turning points in mathematical experiences of six primary teachers. The case study conducted by Drake confirms that turning points are an inestimable source of information for the interpretation of teachers' prior experience with mathematics.

Within this framework, as part of a long-standing Italian research project focused on primary pre-service teachers (Di Martino & Sabena, 2010; Coppola, Di Martino, Pacelli & Sabena, 2012), we carried out a narrative study focused on crucial events for the development of pre-service primary teachers' relationship with mathematics. The goal of the study was to identify recurrent crucial events (and factors involved in these events) in the narrations of future primary teachers, being steered by the following research question:

How do crucial events affect future primary teachers' development of the relationship with mathematics?

METHODOLOGY

Population and procedure

The study involved 145 future primary school teachers enrolled at the University degree for primary school teachers of two different universities: one in the South and one in the North of Italy.

The choice of the research instruments is always not *neutral*, reflecting researchers' values, assumption and beliefs. In particular, there is a variety of different ways of collecting narrative data. We decided to collect autobiographical writing to give respondents *space and time* for thinking what and how narrate. We proposed the following prompt: "*Narrate an episode in your school experience as student that you consider significant for the development of your relationship with mathematics. If possible, describe the details that you remember and the emotions felt. Explain why*

you consider the episode significant".

Respondents were asked to write their narration anonymously, in order to prevent any conditioning aimed at gratifying the reader or at describing a better image of himself (Connelly and Clandinin, 1990, call this phenomenon "the Hollywood plot"). They were asked to provide a nickname, to allow us to combine their narratives to other possible investigations. We will use such nicknames in discussing the results.

The approach to the data

Narrative research is embedded in an interpretive framework: through the collection and analysis of narrative productions, researchers seek to understand, produce sense and interpret the world in terms of its actors and starting from narrators' words (Bell, 2002). Lieblich, Tuval-Mashiach, and Zilber (1998) identify two main independent dimensions in the analysis of narratives, *categorical versus holistic* and *content versus form*:

> The first dimension refers to the unit of analysis, whether an utterance or section abstracted from a complete text or the narrative as a whole. […] The second dimension, that is, the distinction between the content and form of a story, refers to the traditional dichotomy made in literary reading of texts (*ibid.*, p. 12)

We are aware that in many cases the distinctions introduced are not so clear-cut: as Lieblich, Tuval-Mashiach, and Zilber underline, a purely categorical or holistic approach is not possible practically. Moreover, combining the different dimensions permits to grasp a deeper understanding of the collected narratives.

Concerning the first dimension, using an investigator triangulation method, we started with a holistic analysis to identify the narratives that include one or more episodes recognized by the narrator as crucial in the development of his/her personal relationship with math. Then we carried on with a categorical approach in order to recognise factors that are recurrent in the description of the episodes and more in general in the collected narratives.

Also regarding the content/form dimension we developed the analysis through a multiple approach: our attention was mainly focused on content, but we considered particularly significant also the structure of the plot and the occurrence of specific phrases in the narratives.

RESULTS AND DISCUSSION

A first quantitative data analysis indicates that the 39% of the sample does not report an episode as requested in the assignment, but a description of the personal development of the relationship with mathematics during the entire school period. Narrators explain the reasons for not reporting a specific episode; there are two main cases: the relationship with math is perceived by the narrator as stable during school years, without the occurrence of any events that have modified this trend (Margherita writes: "*I have always had a good relationship with math (…) it seems to me that an episode in which this relationship has improved or worsened has never happened*");

the relationship with math is recognized by the narrator as determined by a certain period rather than by a single episode (Nina88 writes: "*I can't remember a specific episode, but an entire school period that changed my relationship with math*"). In this latter case, in analogy with the terminology introduced by Bruner (1990) for a single event, we use the expression *turning period*.

School transitions appear to be the main perceived causes for a turning period (Anonymous: "*Passing from primary school to middle school, it is as if the solid link between me and math was suddenly and magically broken*"): different teachers, topics, practices and also mathematical success criteria often – for better or worse – provoke a *crisis* that can determine a change in the personal relationship with math (Sissi: "*When I arrived to the Lyceum, I was 'traumatized' (...) from that moment on I have had a difficult relationship with mathematics*"; Austin: "*In primary school I had a good approach with math (...) At middle school there was an overturning of the situation, the enthusiasm for the discipline had been reset (...) Fortunately, when I arrived at secondary school there was 'the big turn'*"). This confirms the topicality of the "transition problem*"*, well-known (at least) in western educational systems:

> Students move, in mathematics, from one type of institution with its characteristic culture to another type with another culture, which produces marked discontinuities in the transition process (…) mathematics is perceived and treated so differently at the different levels that one can hardly speak of the same subject, even if it carries the same name throughout the system (Niss, 2003, p. 117).

Most of the time the figure of the teacher is recognized as crucial in the turning periods, even assuming epic traits in the narratives (Hakuna Matata: "*The encounter with these teachers represents* my significant episode"). In the "positive" cases, the teacher is seen as a mentor, sometimes as the unique factor that determines the development of a good relationship with math (Bubby: "*There wasn't an episode that determine my view of math, but a teacher that, through his teaching, has determined the rebirth of my passion for math*"). Conversely, in the "negative" cases, it happens that the teacher is seen as a sort of cruel and detached "persecutor" (Killylilly: *"In middle school, teacher was the reason for my hate for math: she explained, if you were able to understand well, if you were not able to understand she didn't help you (...) I was terrified in classroom*").

> The analysis of the narratives that describe a specific episode (the remaining 61% of our sample) offers several interesting causes to reflection. Future teachers report at least one of the following three reasons for the identification of an episode as significant: i) the episode has caused a change of beliefs; ii) the episode has determined a change in the personal relationship with math (*turning points* for the development of the relationship with math); iii) the episode recalls significant and unexpected emotions.

We will analyse more in depth the case ii), but we want to underline significant common aspects. All the three cases are related to a *rupture*, and the events are often

narrated as vivid although some of them occurred many years ago (Lobianco: "*Primary school, third year, fourth day of school, I remember it as it happened yesterday*"). Moreover, the narrator often reports that recalling the episode still elicits strong emotions (Benedetta, describing an episode happened when she was in grade 2: "*It was autumn, I remember this detail because I was wearing my favourite jersey (…) I remember with fear those minutes. When I close my eyes and think over that episode, I can feel my heart beating faster*").

Analysing the school period the specific episodes referred to, it emerges that, even though the primary school experience is obviously the less recent one, yet the 38% of the narrated episodes refers just to this school period (row 1 in Table 1).

	Primary	Middle	High	University
Narrated episodes	38%	17%	41%	4%
Change of beliefs	33%	20%	27%	20%
Turning points	26%	19%	53%	2%
Emotions	57%	17%	27%	0%

Table 1: School period of the narrated episodes (according to the different typologies)

As researchers and teacher educators, we underline the importance of developing a reflection about the data related to primary period with future primary teachers.

The 57% of the narrated episodes recalling significant and unexpected emotions are placed in the primary school period (row 4 of the table). Furthermore, the 26% of the turning points for the development of the relationship with mathematics is placed in the same period (row 3). In particular, reading the narratives, we highlight the occurrence of terms that characterise strong emotional states such as *very happy, delight, love,* but also *terror, hate, frustration*: for better or for worst, early school experiences with math are strongly charged with emotions. For instance, describing the episode related to a test on multiplication tables, Ale92 writes: "*I was a very anxious child, I was scared (although I knew that there wasn't any punishment), and when I was not able to understand something I used to cry. I was scared to disappoint my parents and the teacher (…) surely my anxiety was triggered by the fact that all my classmates were able to do it well and I wasn't*". In her narration it appears clearly that the strong emotions during mathematics activities are linked to social aspects, which thus influence the development of the negative relationship with math. The social relevance of math is probably one of the reasons because mathematics elicits so strong emotions particularly in primary school: the fear to disappoint parents or teachers, and possibly to get discredit from the classmates, can be very strong.

The social relevance of math seems to determine an interesting peculiarity of mathematics that emerges from the narratives: mathematics has the force to provoke strong opposite feelings and perceptions within the same person (idg: "*Since primary*

school, math was the unique subject able to make me satisfied, confident and in the meantime it was able to make me feel incompetent").

Analysing the *form* of all the narratives that include turning points, we can observe that they are characterized by the occurrences of words such as "*always*", "*never*" and of the expression "*from that moment on*". This data analysis suggests that a turning point in early school years may prematurely determine the student's relationship with mathematics. Furthermore, in case of "negative" turning points (i.e. those episodes that determine the development of a negative relationship) all the subsequent educational choices are affected, even with the outcome of avoiding mathematics as much as possible (Valentina: "*Resulting by this experience* [primary school experience], *I tried to do mathematics the least possible in the following schools, moreover my negative relationship with mathematics affected my decision concerning high school*"). This "avoiding strategy" sometimes prevents the students to pursue some personal drives and can provoke regrets later (Francy: "*Having a second thoughts, I would do the High School of Science: I regret that, at the time, I hadn't the force of make this decision*").

The analysis of turning points

Analysing the *content* of the narratives that include turning points, it emerges that sometimes the turning points are determined by the introduction of some specific topic that represents an insurmountable obstacle (also related to an unexpected failure or decrease in perceived competence) or it is considered meaningless. A typical example of this is the introduction of the letters in algebra (Carmen: "*In grade 11, letters took the place of numbers (...) mathematics become increasingly distant and obscure. I was sure I was never been able to be successful*").

Success, failure and perceived competence represent recurrent factors in turning points. The majority of future primary teachers had not a smooth experience with mathematics, therefore many of them recognize as turning point a school episode of success or failure in mathematics, which determines a strong emotional state (Giu, describing a written exam in grade 6 where she got a very bad mark: "*This episode will be always present in my mind, because it was the mark more humiliating of my school experience. I would have wanted to die from shame!*"), or a significant change in the perceived competence (Meli recognizes her turning point in her first successful written exam in grade 9: "*In Middle school I always had low marks in mathematics, I believed that I wasn't talented at math, therefore I studied it badly and reluctantly (...) at last, after three years, I had overcame a stumbling block, had cancelled the belief that I would never have been able to success in math. From that moment on, I have nurtured my interest for math, and I find a great pleasure in doing it*").

Again, most of the time the teacher strongly affects the consequences of a turning point event: the same event, be it a success or a failure, can have negative or positive development consequently to the teacher's actions. For instance, Nike993 writes that "*My worst experience comes from middle school experiences when, in front of a failure, the negative reactions of the teacher determined the beginning of my hate*

towards mathematics". On the contrary, Fede V. recalls an oral test concerning geometry in grade 10. She had great difficulty: "*In that moment, when I wasn't able to conclude these problems, I felt terrible about myself, an incompetent*". But the teacher did not scold her, and demonstrated instead to consider her difficulties, by underlining that she should not be afraid of making mistakes. This was particularly felt as supporting: "*From that moment on, I began to improve in math and to become fond of geometry*".

Although the consideration of classmates and parents also affect the reactions to and the consequences of success/failure events, the teacher is reported to be the main undisputed factor in the development of turning points. In particular, the importance that the teacher trusts the students' capacities emerges (Franpolla: "*During the High School my relationship with math changed thanks to my teacher. She believed in me and she allowed me to recover the confidence in my math abilities*"). Concerning this aspect, the story narrated by Magiusa is paradigmatic, in the negative: the perception of the teacher's *surrender* represents her turning point for the development of her negative relationship with mathematics: "*the teacher took cognizance of my* white flag*, factually legitimating it and compromising thus any possibility for having interest in the subject"*.

CONCLUSIONS

The relationship with mathematics that future primary teachers have developed during their experiences as students is often strongly negative. The risk is affecting the way pre-service teachers use professional development opportunities and also their future didactical choices when they will be teachers. Studying these relationships, their dynamics and developments seems to be important both as researchers and as teacher educators.

We strongly believe that in order to study these aspects it is crucial to focus on "the ways humans experience the world" (Connelly & Clandinin, 1990, p. 2): "listening" the voice of future teachers through a narrative inquiry to understand their purposes, reasons and actions.

This methodological choice is also an educational choice: asking future teachers to tell about their math story may also represent the early impulse for an in depth reflection about own past experiences and reasons that have affected the development of their personal relationship with math. It is interesting to notice that, in some cases, this impulse also represents a sort of math-therapy: at the end of her narrative (about a love-hate relationship with math), PisoloTo writes: "*I want to underline that telling my story with mathematics helped me a lot…I've never done it before*".

Moreover the methodological choice has influenced the quantity and quality of the data collected. Focusing in detail on the episodes reported as turning points, we were able to identify which factors were perceived as crucial in the development of these events. If it is true that turning points are mainly related to specific episodes of success/failure in mathematics, it is also true that teachers are often the principal actor of the narrated

story: more importantly, most of the times, he/she also strongly affects "the end of the story".

Reflecting on their own experiences and confronting themselves with these results can be useful to future primary teachers to recover their personal relationship with mathematics, and also to become writers of "happy end" stories when they will be again in the classroom.

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